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ON THE STRUCTURE OF SOME PALEOZOIC SPINES FROM OHIO.

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In the TRANSACTIONS of the American Microscopical Society for 1893, I gave some account of the structure of the teeth of the cladodont sharks of Ohio, as found by Dr. Clark in the Cleveland shale of Cuyahoga county. In the present paper I will give a few details of the structure of some spines and teeth from the same field, but from a rather higher horizon, the lower carboniferous.

Overlying the Cleveland shale in which the former species were found is the Berea grit, the lowest of the sandstones of the carboniferous system in Ohio. It is not usually rich in fossils, but its topmost layer at Berea is a solid bed of iron pyrites, about two inches thick, and scattered over this, or imbedded in it, lie numerous spines of different kinds, the most abundant of which is one that was described by Dr. Newberry, in his work on the Paleozoic Fishes of North America, as *Ctenacanthus angustus*. These spines are, of course, in a somewhat imperfect condition, owing to the nature of the preserving medium, but the characters are recognised with little difficulty. It is not improbable that more than one species of *Ctenacanthus* may be present, as species are at present defined.

The spine examined is rather long and slender, gracefully curved, laterally flattened and denticulated along its front edge. In all probability it formed the foremost ray of the dorsal fin of one of the sharks of that time. It is deeply furrowed at the back near the base and was set in the flesh without bony attachment, just as in the spiny sharks, such as the picked dog-fish of the present day. A transverse fracture shows that the hollow at the base is continued up through the spine as a tubular cavity, which simulates the medullary cavity of bone, but has no true analogy with it. This cavity is, of course, now filled with pyrites, and shows dead-black in the field of the microscope. The hard tissue surrounding this medial cavity is homogeneous and penetrated in all parts by large and numerous Haversian (?) canals. These run, in the main, parallel with the length of the spine, but they inosculate continually so as to form a complete network of minute passages, which are also clogged with pyrites and show in strong contrast against the reddish ground of the tissue. So numerous and large are these channels that in many places the empty spaces exceed the solid matter of the spine, which must consequently have been very light in comparison with its size, and therefore better adapted to its duty.

The ground mass of the bone is perfectly solid, without lacunæ or canaliculi, and shows in this point no resemblance to true bone. Traces of a concentric arrangement around the canals (in what may be called the Haversian systems), indicating the method of formation, may, however, be detected.

The structure, evidently, is more like that of tooth than of bone. This is what might be expected, as the spine must be classed with the dermal appendages rather than with the skeleton. The teeth, spines and scutes or scales that more or less cover the bodies of fishes are all special developments of the papillæ of the skin, and though in some kinds of teeth lacunæ are apparently present it is more than doubtful if they are of the same nature as the true lacunæ of bone, except when they are found in the cementum, which is merely the calcified periosteum of the alveolus.

The occurrence of *Ctenacanthus angustus* in the same horizon with *Mazodus*, and the absence of other forms, leads the geologist to suspect that they belonged to the same fish, and in that case one of the names will become a synonym. This, however, belongs to the field of paleontology.

FIG. I.

Spine of *Ctenacanthus angustus—Nby.*

Transverse section, showing Haversian canals.

FIG. II.

Spine of *Ctenacanthus angustus—Nby.*

Longitudinal section, showing central cavity and canals.

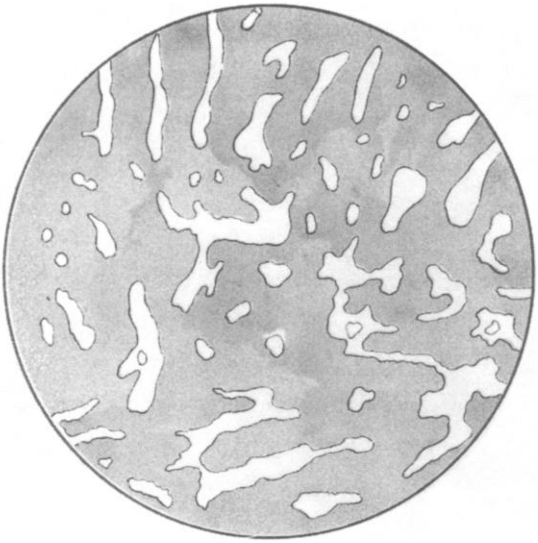

Fig 1.

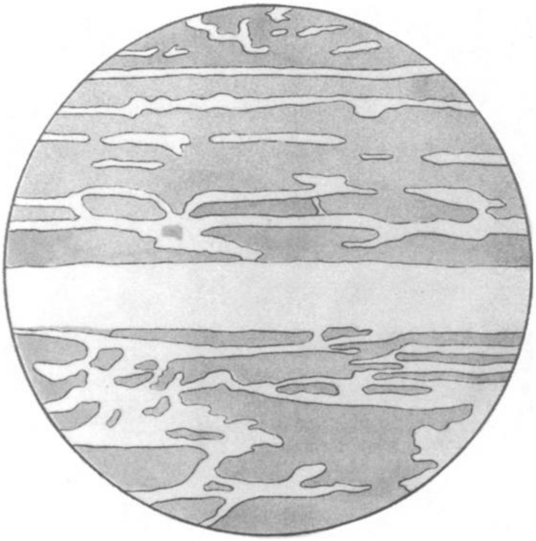

Fig 2.